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RECOVERY OF DIGITAL WAVEFORM DATA FOR EASTERN PUERTO RICO AND THE VIRGIN ISLANDS

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Abstract

Puerto Rico and the U. S. Virgin Islands have a high level of seismic activity, resulting from their location along the boundary between the North America and Caribbean tectonic plates. A felt seismic event occurs about once per month, with several large and damaging earthquakes having occurred during the last 500 years. The region has a 20-year history of digital recordings of local and regional earthquakes from two local networks. Thousands of records exist from small to moderate events, at small-to-regional distances. Many digital waveforms from 1979-1983 recorded by an LDEO-run seismic network in eastern Puerto Rico and east in to the Virgin Islands exist and are stored at LDEO. Data come from 17 well-calibrated stations, 11 of which were in eastern Puerto Rico and the Virgin Islands, 6 were 3-component station, one was broadband and one had a displacement response.

In this project, we recovered seismic station digital waveforms for the time period 1979 - 1983, and permanently archived the recovered data on modem media (CD, DLT tape) at UPR-Mayagüez and Lamont as well as submission of that data, reformatted to AH format, to the IRSI DMC. The recovery will allow incorporation of these data into the current NEHRP ground motion relations development, and will allow many other analyses. In particular, the recovered data can be used to address topics of current interest concerning calibration of a moment magnitude scale, and improvement of earthquake locations, velocity models and focal mechanisms by use of waveforms to determine P/SV ratios. With termination of this project, a major portion of the effort needed to rescue the catalog/bulletin and waveforms data from the seismic network that have monitored seismic activity for the US Territories in the Caribbean will be complete.

Introduction

Puerto Rico's 4 million inhabitants are exposed to a significant earthquake hazard. At least four destructive earthquakes have been experienced in populated areas in historic times. Earthquakes of magnitude 7 or greater are highly probable within the lifetime of the present generation. Despite the substantial seismic hazard, quantitative earthquake hazard analysis is lacking for Puerto Rico. There is an urgent need for the further

analyses. Many of the types of analyses needed, including the development of ground motion relations, require digital waveforms from past-recorded events. Digital data can be processed to extract information concerning source, site, and propagation effects in Puerto Rico and the US Virgin Islands. Unfortunately, many of the digital data recorded in Puerto Rico and the US Virgin Islands are not currently accessible due to their storage on archaic media, for which reading facilities are not easily available. Without speedy intervention, these data will be lost forever.

In this effort, we recovered valuable digital data recorded by the closed LDEO network and permanently archived these data on modern media. Recovered waveform data could be incorporated into a current NEFW project on ground motion relations for Puerto Rico. That project lacks important information in the distance range precisely recorded by this existing, but previously difficult to use data set.

Puerto Rico and the Virgin Islands lie on the boundary between the North American and the Caribbean plates. They are surrounded and crossed by active seismic faults and are a focus of brisk seismic activity. The islands have a significant seismic hazard, as evidenced by the hundreds of moderate (M4 to 5) events recorded in the last two decades. Since Spanish settlement in the early 1500's, there have been at least four destructive earthquakes, with intensities greater than VII on the Modified Mercalli Intensity Scale, causing loss of life and substantial property damage. Two major (M>7) events occurred in this century (1918 and 1943). Historical data show that Puerto Rico has been subjected to a strong earthquake about every 75 years. A possible great earthquake in 1787 (M 8 to 8.2) appears to have occurred along the main seismic zone near the Puerto Rico Trench to the north of the island (McCann, 1985).

Despite its high seismic risk, Puerto Rico lags behind other seismically active regions of the United States in terms of research to adequately assess and mitigate earthquake hazard. This knowledge gap is a subject of major concern within the Puerto Rican scientific and engineering community. Addressing this knowledge gap requires earthquake data, as seismology is largely an empirical science. A large body of data has been recorded, but unfortunately many of these data are archived on outdated media that are no longer generally accessible. Without speedy intervention, these valuable data will be lost forever.

Seismic Monitoring in the Northeastern Caribbean

Puerto Rico and the U. S. Virgin Islands have already benefited from the installation and operation of local seismic stations designed to monitor microearthquake activity. Information collected over the last 20 years has added the definition of local seismic hazard and helped to control the growth of seismic risk. Ongoing revisions of the building code in Puerto Rico are partly a result of investigations using data collected by the local seismic network. The locations of microearthquakes have played an important role in the decision of whether or not to construct important facilities at a given site, and to guide the use of appropriate seismo-resistant design parameters after a site decision has been made. Also, the local seismic network has been able to provide prompt information to the communications media when strong earthquakes have occurred, aiding the education of the general public in earthquake hazards. Unfortunately, because of a complicated history of seismic recording, and a general lack of funding, the existing 20-year database has not yet been fully utilized and part of it is in jeopardy of being lost. Herein we report on the rescue of part of those data.

In 1975 several seismic stations were installed in the Puerto Rico-Virgin Islands region by two organizations, the U. S. Geological Survey (USGS) and Lamont-Doherty Earth Observatory (LDEO). In the period 1982-84

those networks were combined to form the Puerto Rico Seismic Network operated by the University of Puerto Rico. The data collected from 1975-1983 from those separate networks were integrated to form a common catalog and bulletin, under a separate NEFW project to Earth Scientific Consultants. That program added about 9,000 microearthquake locations to the existing local catalog, more than doubling its size.

Brief History of the LDEO Seismic Network

The northeastern Caribbean Network was installed in early 1975 starting in the easternmost part of the Island of Puerto Rico and offshore islands to the east, as well as the U. S. Virgin Islands. Each station consisted of an HS-10 2 Hz geophone, Interproduccts VCO, and information was relayed by FM radio to a central recording site. Later many stations were increased to two components each and finally three. In the last few years a broadband station was added at VST and a displacement response at SJV. At the central recording station, data were first recorded on heliocorders and on 16mm film by use of a developocorder, and in 1979 by a digital recording system of LDEO design. Events were located using at first using *Hypoellipse* then later *Hypoinverse*. Bulletins reporting phase information and locations were published for data from at least 1977 until the end of 1982. Digital data for events in the last six months of network operation (1983) were neither interpreted nor locations determined. All events were located using the one velocity model though later a model was determined through inversion of event arrival times and multi-ton calibration shots (Fischer and McCann, 1984).

Formation of the Puerto Rico Seismic Network

Starting in the end of June 1982, operational responsibility of the USGS seismic network was transferred to the Center for Energy and Environmental Research (CEER) of the University of Puerto Rico. From that time through June 1987, network support included basic collection, interpretation and processing of seismic data. The antiquated developocorder style recording was replaced by an event triggered digital recording system of LDEO design. Continuous heliocorder recording was also added.

Both LDEO and USGS provided help in setting up the data processing system, with the LDEO crustal model (used by LDEO in the Virgin Islands) used in HYPOINVERSE to locate events. About June 1983 the LDEO network in the Virgin Islands was dismantled with some equipment shipped to the Dominican Republic. As part of a USGS funded program, six 3-component stations of the closing LDEO network in the Virgin Islands were transferred to the existing stations on the Island of Puerto Rico to form a 21-station Puerto Rico Seismic Network.

Operation of the network was transferred to the Geology Department, University of Puerto Rico, Mayagüez on June 22, 1987. Since that time the recording system has been upgraded to use the PC based IASEPI data collection in conjunction with a system developed by the University of the West Indies. Earthquakes are still located using *Hypoinverse*, but a new crustal model has been introduced. A new magnitude scale has also been introduced, based on a desired equivalence to teleseismic m_b , but there remain unresolved questions concerning the calibration of this regional magnitude scale.

The net result of the above history is that catalogs of events near Puerto Rico and the Virgin Islands contain events located by two separate networks, using at least two different computer programs, with at least two

different crustal models. Event magnitudes are calculated based on at least two different scales of uncertain equivalence.

A recent NEHRP effort merged phase arrival times, amplitudes and coda times for events from the period of common USGS~LDEO network operation and data reduction (1975-1978). That data, and the data from the LDEO network alone (1979-1982) were located using the same location program, velocity model, and magnitude parameters to form a uniform event catalog and bulletin covering the period 1975-1982. Nearly 9,000 events were recovered by that effort (McCann, 2001).

Efforts Undertaken

The goal of this project was to rescue the data available on magnetic tape from the former LDEO network, covering the time period from 1979-1983, and archive all of these data on modern media. This information includes digital records from a total of 17 stations; one is a broadband station, one with a displacement response, and 6 3-component stations. It includes records of at least 2300 local earthquakes, and 3 multi-ton calibration shots in 1976 and 1979. Calibration shots from the 1982 campaign are also included in the normal network digital data set.

The tasks required for this project involved substantial, but simple, data recovery efforts. At LDEO there are 239 digital tapes covering the period from April, 1979 through May, 1983. These 1/2" 800bpi tapes contain event triggered multiplexed digital records of earthquakes waveforms recorded by the 17-station LDEO seismic network in the NE Caribbean. They contain information for at least 2,315 local and regional earthquakes. Waveform data were recorded by a digital recording system of LDEO design in a proprietary format. Approximately 50 of these tapes have their information already copied in demultiplexed format. So about 189 tapes were read and data demultiplexed. After being demultiplexed the time series were reformatted into a non-orphaned format thereby making it usable by the general scientific community. Auxiliary files with station gain/polarity information are already available having been recovered and copied as part of a previous NEHRP grant to Earth Scientific Consultants. The archived waveform database will be available through IRIS-DMC and a copy of the data will also be held at the offices of the seismic network of Puerto Rico. It is expected that this data will be a valuable resource in ground motion studies.

Summary of Data Rescue Efforts

Tapes were read on a 800bpi 1/2" track tape reader (Kennedy 9300). Reader would not recognize tape EOF, so copies, that is images of a whole tapes, were made by the command

```
tcopy /dev/rmt0m > tape#
```

Images have been saved in the event that someone needs to examine in an attempt to retrieve information of a particular event that was not successfully retrieved during the normal processing. All tapes (numbers 1-252) were read successfully. Of those tapes, #s 1-240 are from the LDEO NE Caribbean network and #s 241-252 are from the Puerto Rico network. A mystery tape, contained the ring label duplicate to another LDEO network tape, but had no information on it. An image index of all tapes was produced and is given in Appendix A. That

appendix includes tape number date on and off information, any special notes, and what channels were recorded etc.

LDEO programer David Lentrichia wrote a program, CARICLEAN, to break up a tape image into its component files and to clean up problems associated with minor losses of information that would damage the demultiplexing process. CARICLEAN generated raw carib network files that were further processed by the command "Tdmux -yr -f", This program demultiplexed the data and wrote it in AH format. Data were checked by use of PQL (passcal quick look) to make sure that the demultiplexing process was successful. The vast majority of the raw data were demultiplexed and converted to AH format with out problems. It is self-evident in the data which files are good.

A problem was encountered during the 79/80 year transition. As the digital recording system did not record the years, only sequential day of year and smaller time units, one had to provide the year in the demultiplex process. At the end of 1979 the station attendants did not change the clock to day 001 on January 1, 1980, so it indicated day 366 for that day. Events at the end of 1979 were processed using the year 1979 and were processed correctly. However when the 1980 events on the same tape were processed using the year 1980, tdmux interpreted the day 366 as December 31, 1980 as 1980 is a leap year, thus assigning an incorrect date for those events on January 1, 1980. As we have no solution for the problem, any users encountering data on tape #60 must realize that the data have a problem with the data information, but that the waveform data are good.

Station lists providing equipment inventories were developed. That file provides several unique response types for the various digital stations. A history of each station and its components includes gain and response type.

In order to provide a patch for the data not successfully processed using the program tdmux, we used the information copied onto a DLT tape about 5 years ago in a predecessor to this project. That data consisted of 9 archived tapes of demultiplexed data. We processed that information using the program ping2ah to make one file in AH format. A C-shell script then called the program uncatah, broke the large file into individual components which were in turn renamed according to a list produced when the original archive tapes were dmultiplexed in 1983. In some cases the number of files retrieved from the DLT for a given archive tape did not correspond to the number of files originally placed on the tape. Those datasets were left unprocessed; while the data could be retrieved reading the header files, the process was deemed to be too time consuming and beyond the scope of this present program. If an event of particular interest was not successfully processed by tdmux, and is found to be on one of the problematic tapes, a search through the unprocessed archive data tape might be worthwhile. More detailed information about what was processed is to be found in Appendix A.

Digital Waveform Products

Four institutions hold the final digital waveform products of this effort. They are LDEO Seismology Group, Seismic Network of Puerto Rico, IRIS DMC, and Earth Scientific Consultants. LDEO hold the original DLT tapes containing the tape images and AH format data, and files containing station parameters including location, calibration and response information. The other institutions were provided a set of CDs with tape images and AH format data, and station parameter files. Copies of this final report, without the CD dataset, were distributed to researchers working on various aspects of the seismic hazards and neotectonics of the U.S. Caribbean Territories.

Appendix A.

This appendix contains details of tape files created during copying and processing. All original data are stored on a DLT tape at LDEO (Seismology Building, Room 106D, red filing cabinet). A copy of the Tape Images and AH- format data were also copied to CD-ROM and are held at the Seismic Network in Puerto Rico and at the offices of ESC. AH format data are also held in the IRIS DMC.

Step I-- Produce Tape Image: 252 files named Tape1 through Tape252 are located in the directory "images" on the DLT tape. Below is an index of the 252 magnetic tape images (9-track, 800 bpi, $\frac{1}{2}$ ") read by *tcopy*. The index provides the relation between tape number (1-252) and date of information contained therein. List also notes channels file to use in demultiplexing process and notes year-year changes as well as notes that were hand written onto tapes.

Index of $\frac{1}{2}$ " Magnetic Tape Images Read by *tcopy*

FILE	--DATEON---	--DATEOFF--	NOTES
tape1	032979	1200	040879 1415 start with channels0 file
tape2	040879	1425	042079 0200
tape3	042079	0210	042779 1356
tape4	042779	1402	050279 1203
tape5	050279	1210	050879 2315
tape6	050879	2323	051379 1435
tape7	051379	1444	051879 2106
tape8	051879	2115	052279
tape9	052279	2327	052879 2120
tape10	052879	2127	060579 1518
tape11	060579	1522	060579 2317
tape12	060579	2323	061179 1052
tape13	061179	1058	061679 2226
tape14	061679	2234	062379 1031
tape15	062379	1040	063079 2258
tape16	063079	2308	070779 0826
tape17	070779	0831	071079 2345
tape18	071079	2353	071479 1517
tape19	071479	1529	072079 0254
tape20	072079	0259	072179 1430
tape21	072179	1437	072179
tape22	072179	2148	072279
tape23	072279	1053	072379
tape24	072379	1034	072879
tape25	072879	0145	073179 0141
tape26	073179	0230	073179 0300 note 1
tape27	073179	0300	080479 1336 note 2
tape28	080479	1343	080779 2220 note 3
tape29	080779	2230	081079 1813 note 4
tape30	081079	1818	081779 2300
tape31	081779	2302	082279 1307
tape32	082279	1312	082479 1700 note 5
tape33	082479	1700	082679 1531 note 6

FILE	--DATEON---	--DATEOFF--	NOTES
tape34	082679	1536	082879 1500 note 7
tape35	082879	1510	082979 2323 note 8
tape36	090179	1230	091079 2000 note 9
tape37	091079	2030	091279 2254 note 10
tape38	091279	2259	091479 1610 note 11
tape39	091479	1615	091879 0125
tape40	091879	0128	092379
tape41	092379	1442	092579
tape42	092579	2316	100679 2124
tape43	100679	2130	101179 2257
tape44	101179	2303	101779 2333
tape45	101779	2345	102279 1612
tape46	102279	1619	102879 2307
tape47	102879	2325	110279 2355
tape48	110379	0000	111479 1719
tape49	110579	1723	110979 2235
tape50	110979	2240	111579 2250
tape51	111579	2256	111979 2331
tape52	111979	2337	112479 2307
tape53	112479	2312	120179 0942 Note 12 channels0/1 at 11/30/79 0000
tape54	120179	0947	120779 0053
tape55	120779	0100	121179 2250 end channel1
tape56	121179	2300	121279 2255 Note 13 start channels2 at 11/11/79 2300
tape57	121279	2303	121579 2245
tape58	121579	2253	122179 2251
tape59	122179	2302	122879 2257
tape60	122879	2305	010280 0353 change year 79/80
tape61	010280	1048	010580 2355
tape62	010580	2357	010780 1055
tape63	010780	1100	011080 1222
tape64	011080	1227	011580
tape65	011580	0321	
tape66	011680	1133	011680
tape67	011680	2222	011780 0305
tape68	011780	0309	011780 1129
tape69	011780	1133	111880 1107
tape70	011880	1112	012080 0343
tape71	012080	0348	012380 1124
tape72	012380	1128	012580 1130
tape73	012580	1134	012880 2328
tape74	012880	2334	020380 1114
tape75	020380	1118	020880 2342
tape76	020880	2347	021480 1110
tape77	021480	0114	021680 0103
tape78	021680	0106	022280 2249
tape79	022280	2253	022780 2353
tape80	022780	2358	030380
tape81	030380	1504	030880 0005
tape82	030880	0006	031480 2229

FILE	--DATEON--	--DATEOFF--	NOTES
tape83	031480		
tape84	031680	2155	032280 0210
tape85	032280	0214	032680 1033
tape86	032680	1038	040280
tape87	040280		040680 1452
tape88	040680	1457	041380 2342
tape89	041380	2346	
tape90	042280	1022	050280 1130
tape91	050280	1135	051180 2330
tape92	051180	2340	051980 1230 Note14 channels2/3 5/16/80 0000
tape93	051980	1240	052580 1359
tape94	052580	1405	052780 1630
tape95	052780	1638	053180 2216
tape96	053180	2223	060580 1238
tape97	060580	1243	061080 1154
tape98	061080	1159	061780 1543
tape99	061780	1548	062380 2231
tape100	062380	2237	063080
tape101	062980	1342	070880 1702
tape102	070880	1706	072080 2159
tape103	072080	2203	080480 1807
tape104	080480	1812	081380 0646
tape105	081380	0653	082080 2211
tape106	082080	2215	090180 2154
tape107	090190	2159	
tape108	090480	0954	090680 1226
tape109	090680	1231	090780 2255
tape110	090780	2259	091780 2245
tape111	091780	2251	092780 1331
tape112	092880	1337	101380 2205
tape113	101380	2210	103180 0949
tape114	103180	1010	110880 1156
tape115	110880	1201	111180 2037
tape116	111180	2041	111380 2043
tape117	111380	2047	111780 1048
tape118	111780	1052	112080 2006
tape119	112080	2010	112580 0111
tape120	112580	0115	112880 2247
tape121	112880	2252	120280 0749
tape122	120280	1016	120380 2335
tape123	120380	2338	120780 2259
tape124	120780	2304	121180 2207
tape125	121180	2212	121680 0204
tape126	121680	0226	122080 1843
tape127	122080	1849	122780 1034
tape128	122780	1038	123180 1853
tape129	123180	1858	010481 0845 change year 80/81
tape130	010481	0852	010881 1449
tape131	010881	1449	011181 2346

FILE	--DATEON--	--DATEOFF--	NOTES
tape132	011181	2354	011681 1602
tape133	011681	1608	012181 1102
tape134	012181	1109	012381 2254
tape135	012381	2259	012981
tape136	012981	1049	021181 2245
tape137	021181	2313	022281
tape138	022281	2234	030181 1245
tape139	030181	1250	030681 2328
tape140	031681	2332	032181 1206
tape141	032181	1210	040381 0023
tape142	040381	0029	042181 2245
tape143	042181	2250	050381 2228
tape144	050381	2230	051781 0009
tape145	051781	0013	052781 2302
tape146	052781	2307	
tape147	061281	1026	062781 1443
tape148	062781	1447	070781 1241
tape149	070781	1247	071581 2022
tape150	071581	2026	072281 2244
tape151	072281	2249	072781 2340
tape152	072781	2340	073081 0100
tape153	073081	0102	080181 2050
tape154	080181	2053	081481 0152
tape155	081481	0152	082181 2038
tape156	082181	2046	082781 0038
tape157	082781	0043	
tape158	082881	1140	090381 2315
tape159	090381	2320	092181 2218
tape160	092181	2222	100481 1813
tape161	100481	1815	101381 2151
tape162	101381	0255	101581 2204
tape163	101581	2205	101681 2222
tape164	101681	2224	102281 2142
tape165	102281	2257	110381 2133
tape166	110381	2139	110581 2253
tape167	110581	2255	111281 2322
tape168	111281	23	112581 2138
tape169	112581	2143	112981 2200
tape170	112981	2204	120281 2146
tape171	120281	2150	120781 2153
tape172	120781	2157	121581 1230
tape173	121581	1235	121981 2257
tape174	121981	2259	122581 1915
tape175	122581	1920	010982 2055 change year 81/82
tape176	010982	2100	012282 2100
tape177	012282	2106	020182 2132
tape178	020182	2136	021582 2107
tape179	021582	2112	021882 2104
tape180	021882	2108	022582 2112

FILE	--DATEON--	--DATEOFF--	NOTES
tape181	022582	2116	022882 2152
tape182	022882	2155	030282 2134
tape183	030282	2139	030582 2140
tape184	030582	2145	031282 2166
tape185	031282	2122	031482 2116
tape186	031482	2120	032082 1404
tape187	032082	1408	
tape188	040182	2124	040582 2119
tape189	040582	2124	042682 2059
tape190	042682	2103	050382 2109
tape191	050382	2115	052382 1653
tape192	052382	1658	061382 1633
tape193	061382	1642	062382 1627
tape194	062382	1633	070482 1651
tape195	070482	1655	071782 1632
tape196	071782	1641	
tape197	072982	2059	080182 2120
tape198	080182	2125	081482 1301
tape199	081482	1305	
tape200	082082	2326	083182 1609
tape201	083182	1615	091182 1538
tape202	091182	1543	091482 1700
tape203	091482	1704	092182 1552
tape204	092182	1558	100982 1549
tape205	100982	1550	102782 1444
tape206	102782	1449	111982 1504
tape207	111982	1510	112482 1514
tape208	112482	1517	120582 1722
tape209	120582	1728	121582 1432
tape210	121682	1442	
tape211	121782	1500	122582 1536
tape212	122582	1541	122882 1430
tape213	122882	1426	010383 1610 change year 82/83
tape214	010383	1617	011383 1544
tape215	011383	1549	012483 1651
tape216	012483	1706	020283 1546
tape217	021683	1615	022083 1618
tape218	021183	1606	021683 1610
tape219	020283	1552	021183 1602
tape220	022083	1624	030383 1608
tape221	030383	1611	030983 1736
tape222	030983	1741	031883 1630
tape223	031883	1636	032283 1412
tape224	032283	1417	032683 1647
tape225	032683	1653	032983 1550
tape226	032983	1604	040383 1653
tape227	040383	1700	040783 1600
tape228	040783	1605	
tape229	040883	1604	041183 1508

FILE	--DATEON--	--DATEOFF--	NOTES
tape230	041183	1515	041383 1526
tape231	041383	1534	041683 1600
tape232	041683	1601	
tape233	042583	1710	050183 1619
tape234	050183	1627	050583 1527
tape235	050583	1534	051183 1646
tape236	051183	1655	051583 1804
tape237	051583	1810	
tape238	052783	1640	053183 1707
teap239	053183	1710	061483 1742
tape240	061683	1748	061783 1705 end of LDEO network tapes
tape241	011785	1906	012485 2413 change year 83/85 note 15
tape242	110985	1136	112985 1051
tape243	112985	1101	010286 2300 change year 85/86
tape244	010286	2351	012886 1100
tape245	012886	1111	022786 0317
tape246	022786	0320	033186 1912
tape247	033186	1917	042486 0040
tape248	042486	0043	860505 0233
tape249	050586	0236	051886 1658
tape250	051886	1720	052986 0322
tape251	052986	0327	060586 1823
tape252	060586	1842	061786 1013

General Note: Dateon and Dateoff give month, day, year in one column and hour, minute in next column. Blank entry means information not given. Use channels0 from start of digital data for channels assignments and demultiplexing raw data.

Note1: "Test" is marked on tape

Note2: offtime is approximate

Note3: VST calibration starts at 080779 014506

Note4: SJV calibration starts at 081089 133133

Note5: refraction profiles 1-6 and start of 7 on this tape.

Note6: End of refraction profile 7 on this tape.

Note7: Multiton calibration shot #1 (east of ABV) is on tape #34.

For this shot special channels assignments for the sonobouy signals are as follows: y1a=31, y2a=21,32, y3a=24, y4a=4.

Note8: tape35- Two multiton calibration shots are on tape #35.

These are shots #2 (N of vst) and #3 (east of ABV again).

For shot #2 special channel assignments for the sonobouy signals

are as follows: y2b=24, y3b=4,31, y4b=21, y5b=32.

Also, power out so no tape for 082979 2323 to 090179 1230.

Note 9: Refraction lines 9-11 on this tape.

Note 10: Refraction lines 12,13 on this tape.

Note 11: Refraction lines 14-16 on this tape.

Note12: Station STKP moved to SKBR, change in channels file 11/30/79 0000, use channels1 file.

Note13: Station SAB moved to SBN, change in channels file 12/11/79 2300, use channels2 file.

Note14: New station channel assignments start 05/16/80 0000, use channels3 file.
Note 15: Start of PR network tapes, use channels4; cannot read this tape so no image or follow up files, next tape really begins recording sequence for PR network.

STEP II-- Process 252 tape images through CARICLEAN to generate individual files containing RAW Caribbean network digital waveforms and header files.

These data are located in the directory "cleaned" on the DLT Tape. In "cleaned" there are subdirectories each having the name of a tape (i.e. tape104, etc.). Within each subdirectory are a series of files in the order in which they were found on the tape. So file.06 in directory tape213 is the 6th file found on tape #213, etc.

STEP III-- Process the files reformatting them from raw, multiplexed Caribbean network data format to AH format. These data are located in the directory "ahdata" on the DLT tape. In 'ahdata' there are subdirectories each having the name of a tape followed by ah (i.e. tape213.ah). Within each subdirectory are a series of directories named by the time of the event trigger and within those directories are the data in AH format. Each file is named after the channel whose data is contained therein. So data for channel ABVN for event triggered on 821229.102555 would be found in ahdata/tape213.ah/821229.102455/abvn.
Any station files with the names zzz, zzy, and zzx should be ignored, as they contain no data. All raw data and data processed up to and including this step should have 0.5 seconds added to their times to obtain UCT.

Files known or suspected to have suffered a problem during the *tcopy* or CARICLEAN step and may not contain reliable waveforms

Appendix B
Channels files

Channels0	Channels1	Channels2
1 csj 100	1 csj 100	1 csj 100
2 csje 100	2 csje 100	2 csje 100
3 rrd 100	3 rrd 100	3 rrd 100
4 rrde 100	4 rrde 100	4 rrde 100
5 mtp 100	5 mtp 100	5 mtp 100
6 mtpe 100	6 mtpe 100	6 mtpe 100
7 cup 100	7 cup 100	7 cup 100
8 cupe 100	8 cupe 100	8 cupe 100
9 cgv 100	9 cgv 100	9 cgv 100
10 cgve 100	10 cgve 100	10 cgve 100
11 scv 100	11 scv 100	11 scv 100
12 scve 100	12 scve 100	12 scve 100
13 sjv 100	13 sjv 100	13 sjv 100
14 sjve 100	14 sjve 100	14 sjve 100
15 cgp 100	15 cgp 100	15 cgp 100
16 cgpe 100	16 cgpe 100	16 cgpe 100
17 gpv 100	17 gpv 100	17 gpv 100
18 gpve 100	18 gpve 100	18 gpve 100
19 abv 100	19 abv 100	19 abv 100
20 abve 100	20 abve 100	20 abve 100
21 swi 100	21 swi 100	21 swi 100
22 sab 100	22 sab 100	22 sbn 100
23 mrn 100	23 mrn 100	23 mrn 100
24 stk 100	24 skb 100	24 skb 100
25 awi 100	25 awi 100	25 awi 100
26 bwi 100	26 bwi 100	26 bwi 100
27 vst 100	27 vst 100	27 vst 100
28 vste 100	28 vste 100	28 vste 100
29 vstn 100	29 vstn 100	29 vstn 100
30 zzx 100	30 zzx 100	30 zzx 100
31 zzy 100	31 zzy 100	31 zzy 100
32 zzz 100	32 zzz 100	32 zzz 100

Channels3
1 mtp 100
2 mtpn 100
3 mtpe 100
4 cup 100
5 cupn 100
6 cupe 100
7 sjv 100
8 sjvn 100
9 sjve 100
10 cgp 100
11 cgpn 100
12 cgpe 100
13 abv 100
14 abvn 100
15 abve 100
16 csj 100
17 rrd 100
18 cgv 100
19 scv 100
20 gpv 100
21 swi 100
22 sbn 100
23 mrn 100
24 skb 100
25 awi 100
26 bwi 100
27 vst 100
28 vstn 100
29 vste 100
30 bst 100
31 bstn 100
32 bste 100

Channelspr
1 lpr 100
2 cpd 100
3 cdp 100
4 cdpn 100
5 apr 100
6 pnp 100
7 mgp 100
8 mcp 100
9 imo 100
10 sjg 100
11 csb 100
12 mov 100
13 ide 100
14 lrs 100
15 100
16 100
17 sjv 100
18 sjvn 100
19 sjve 100
20 cgpv 100
21 cgpvn 100
22 cgpve 100
23 mtp 100
24 mtpn 100
25 mtpe 100
26 csj 100
27 abv 100

Appendix C

Station Information

Station coordinates, components, operating times and polarities in Hypoellipse format

abv18	43.92	64	20.22	3	1		e
abv*	4	1	1			1983061823	R
abv18	43.92	64	20.22	3	1		n
abv*	4	1	1			1983061823	R
abv18	43.92	64	20.22	3	1		z
abv*	4	1	1			1977070123	?
abv*	4	1	1			1977120923	N
abv*	4	1	1			1978082123	?
abv*	4	1	1			1979032523	N
abv*	4	1	1			1981020823	R
abv*	4	1	1			1983061823	N
apr18	27.45	66	43.76	53	2		z
apr*	4	1	1			1999123123	N
bwi17	39.90	61	47.40	36	1		z
bwi*	4	1	1			1979082023	N
bwi*	4	1	1			1980051223	R
bwi*	4	1	1			1981021323	R
bwi*	4	1	1			1983061823	N
cag18	14.37	66	02.12	350	2		z
cag*	4	1	1			1975071723	
cca18	04.18	66	19.58	269	2		z
cca*	4	1	1			1999123123	N
cdp18	10.50	66	35.50	1300	2		z
cdp*	4	1	1			1999123123	N
cgv18	7.97	65	19.04	130	1		z
cgv*	4	1	1			1979080323	R
cgv*	4	1	1			1981030223	N
cgv*	4	1	1			1983061823	N
cpd18	02.33	65	54.91	370	2		z
cpd*	4	1	1			1999123123	N
csb18	17.35	66	09.35	480	2		z
csb*	4	1	1			1999123123	N
csj18	22.98	65	37.08	66	1		z
csj*	4	1	1			1977100123	?
csj*	4	1	1			1978060623	?
csj*	4	1	1			1978121223	N
csj*	4	1	1			1979080423	R
csj*	4	1	1			1980110723	R
csj*	4	1	1			1981020223	R

csj*	4	1 1	1979123123	N	
csj*	4	1 1	1982111923	N	
csj*	4	1 1	1983061823	N	
cup18	20.10	65 18.54	120 1	e	
cup*	4	1 1	1983061823	N	n
cup18	20.10	65 18.54	120 1	N	
cup*	4	1 1	1983061823	N	z
cup18	20.00	65 19.83	120 1	N	
cup*	4	1 1	1976101023	?	20.1018.53 120
cup*	4	1 1	1977061623	N	20.1018.53 120
cup*	4	1 1	1979022823	N	20.1018.53 120
cup*	4	1 1	1979041823	N	20.1018.53 120
cup*	4	1 1	1979120823	N	20.1018.53 120
cup*	4	1 1	1980042023	R	20.1018.53 120
cup*	4	1 1	1981020623	R	20.1018.53 120
cup*	4	1 1	1983061823	N	20.1018.53 120
cyp18	06.70	66 09.00	457 2		
cyp*	4	1 1	1999123123	N	
dos18	19.77	66 40.73	400 2		
dos*	4	1 1	1999071723	N	
eyp18	18.75	65 47.50	1060 2		
eyp*	4	1 1	1999123123	N	
gpv18	29.52	64 24.24	1		
gpv*	4	1 1	1979080123	N	
gpv*	4	1 1	1981020123	R	
gpv*	4	1 1	1983061823	N	
ide18	23.19	67 29.77	218 2		
ide*	4	1 1	1999123123	N	
imo18	06.69	67 54.51	84 2		
imo*	4	1 1	1999123123	N	
imr18	05.30	67 50.83	55 2		
imr*	4	1 1	1999123123	N	
lpr18	18.52	65 52.16	580 2		
lpr*	4	1 1	1999123123	N	
trs18	17.60	66 50.70	440 2		
trs*	4	1 1	1999123123	N	
lsp18	10.65	67 05.16	390 2		
lsp*	4	1 1	1999123123	N	
mcp18	25.13	67 06.63	250 2		
mcp*	4	1 1	1999123123	N	
mgp18	00.45	67 05.35	60 2		
mgp*	4	1 1	1999123123	N	
mov18	16.92	66 22.00	485 2		
mov*	4	1 1	1999123123	N	
mpr18	12.76	67 08.35	20 2		

mpr*	4	1 1	1999123123	N	
mrn18	00.72	63 03.60	20 1		z
mrn*	4	1 1	1979081723	R	
mrn*	4	1 1	1980110723	R	
mrn*	4	1 1	1981022123	R	
mrn*	4	1 1	1983061823	N	
mtp18	5.64	65 33.42	175 1		e
mtp*	4	1 1	1999123123	N	
mtp18	5.64	65 33.42	175 1		n
mtp*	4	1 1	1999123123	N	
mtp18	5.64	65 33.42	175 1		z
mtp*	4	1 1	1977070123	?	
mtp*	4	1 1	1977101223	N	
mtp*	4	1 1	1978031323	?	
mtp*	4	1 1	1978060923	N	
mtp*	4	1 1	1978121323	N	
mtp*	4	1 1	1979080223	R	
mtp*	4	1 1	1980041723	R	
mtp*	4	1 1	1980110723	R	
mtp*	4	1 1	1981020723	N	
mtp*	4	1 1	1983061823	N	
pnp18	03.58	66 46.00	200 2		z
pnp*	4	1 1	1999123123	N	
pon18	00.20	66 36.83	50 2		z
pon*	4	1 1	1999071723	N	
pwp18	08.10	65 26.70	10 1		z
pwp*	4	1 1	1977073123	?	
pwp*	4	1 1	1977103123	R	
pwp*	4	1 1	1978031323	R	
rrd18	14.16	65 37.08	40 1		z
rrd*	4	1 1	1978120123	?	
rrd*	4	1 1	1979080923	?	
rrd*	4	1 1	1979081623	R	
rrd*	4	1 1	1980110723	R	
rrd*	4	1 1	1981020223	R	
rrd*	4	1 1	1982111423	N	
sbn17	38.22	63 14.10	870 1		z
sbn*	4	1 1	1977103123	R	
sbn*	4	1 1	1979081823	R	
sbn*	4	1 1	1979120223	R	
sbn*	4	1 1	1980110723	R	37.2313.60 470
sbn*	4	1 1	1981022323	R	
sbn*	4	1 1	1983061823	N	
scv17	46.90	64 47.34	12 1		z
scv*	4	1 1	1976112123	?	

scv*	4	1 1	1977070123	?
scv*	4	1 1	1977101023	?
scv*	4	1 1	1977121023	R
scv*	4	1 1	1979032823	R
scv*	4	1 1	1980042623	N
scv*	4	1 1	1980052623	N
scv*	4	1 1	1980110723	R
scv*	4	1 1	1981020523	R
scv*	4	1 1	1982111623	N
sjg18	06.70	66 09.00	457 2	z
sjg*	4	1 1	1999123123	N
sjv18	20.70	64 45.72	280 1	e
sjv*	4	1 1	1999123123	N
sjv18	20.70	64 45.72	280 1	n
sjv*	4	1 1	1999123123	N
sjv18	20.70	64 45.72	280 1	z
sjv*	4	1 1	1977061423	?
sjv*	4	1 1	1978061023	R
sjv*	4	1 1	1978081823	N
sjv*	4	1 1	1979080823	R
sjv*	4	1 1	1980110723	R
sjv*	4	1 1	1981013123	R
sjv*	4	1 1	1983061823	N
vst18	21.24	64 57.42	372 1	e
vst*	4	1 1	1983061823	N
vst18	21.24	64 57.42	372 1	n
vst*	4	1 1	1983061823	N
vst18	21.24	64 57.42	372 1	z
vst*	4	1 1	1977070123	?
vst*	4	1 1	1977081923	N
vst*	4	1 1	1977103123	N
vst*	4	1 1	1977123123	N
vst*	4	1 1	1978033123	N
vst*	4	1 1	1978063023	N
vst*	4	1 1	1978083123	N
vst*	4	1 1	1979013023	N
vst*	4	1 1	1979041623	N
vst*	4	1 1	1979051623	R
vst*	4	1 1	1979083123	R
vst*	4	1 1	1980110723	R
vst*	4	1 1	1981022623	R
vst*	4	1 1	1983061823	N
awin17	02.70	61 51.60	371 1	z
awin*	4	1 1	1978112723	?
awin*	4	1 1	1979121823	R

awin*	4	1 1	1981022023	R
awin*	4	1 1	1982112523	N
awin*	4	1 1	1983061823	N
cagu18	14.37	66 02.12	350 1	z
cagu*	4	1 1	1999071723	N
cgpv17	45.81	64 35.02	40 1	e
cgpv*	4	1 1	1983061823	N
cgpv17	45.81	64 35.02	40 1	n
cgpv*	4	1 1	1983061823	N
cgpv17	45.81	64 35.02	40 1	z
cgpv*	4	1 1	1978121523	R
cgpv*	4	1 1	1979040123	N
cgpv*	4	1 1	1979083123	N
cgpv*	4	1 1	1979120923	N
cgpv*	4	1 1	1980041923	N
cgpv*	4	1 1	1980042423	R
cgpv*	4	1 1	1980110723	R
cgpv*	4	1 1	1981020423	R
cgpv*	4	1 1	1983061823	N
cllp18	04.23	66 34.53	195 2	z
cllp*	4	1 1	1999123123	N
porp18	03.23	66 38.22	165 2	z
porp*	4	1 1	1999123123	N
sjgc18	06.70	66 09.00	457 2	z
sjgc*	4	1 1	1999123123	N
skbr17	20.46	62 50.40	1	z
skbr*	4	1 1	1981021723	R
skbr*	4	1 1	1983061823	N
stkp17	22.80	62 49.62	366 1	z
stkp*	4	1 1	1978120123	N
stkp*	4	1 1	1979112823	R
swip18	35.88	63 25.56	15 1	z
swip*	4	1 1	1977101623	?
swip*	4	1 1	1978090123	?
swip*	4	1 1	1979081623	N
swip*	4	1 1	1979121623	R
swip*	4	1 1	1980050423	R
swip*	4	1 1	1980110723	R
swip*	4	1 1	1981021523	R
swip*	4	1 1	1983061823	N
tcgo18	08.75	66 58.87	880 2	z
tcgo*	4	1 1	1999123123	N
vstb18	21.24	64 57.42	372 1	e
vstb*	4	1 1	1983061823	N
vstb18	21.24	64 57.42	372 1	n

vstb* 4 11 1983061823
vstb18 21.24 64 57.42 372 1
vstb* 4 11 1983061823

N Z
N

Appendix D
Calibration Information

Calibration of natural frequencies of 3 component Stations (component, date, natural frequency in Hz)
MTPZ 11/13/82 1.01

CGPVZ 04/29/80 2.1

CGPVZ 02/04/81 2.2

CGPVZ 02/04/81 1.05

CGPVZ 11/05/82 1.15

MTPN 12/23/81 1.16

MTPN 11/13/82 1.01

CGPVN 03/19/79 1.0

CGPVN 04/29/80 1.4

CGPVN 02/04/81 4.5

CGPVN 02/04/81 1.3

CGPVN 11/05/82 1.15

MTPE 12/23/81 1.09

MTPE 11/13/82 0.97

CGPVE 11/01/78 1.0

CGPVE 04/29/80 1.0

CGPVE 02/04/81 1.18

CGPVE 11/05/82 1.16

ABVN 02/08/81 1.14

ABVN 11/22/82 2.04

SJVZ 05/01/80 2.2

SJVZ 08/01/80 2.2

SJVZ 01/31/81 1.1

SJVZ 11/09/82 1.05

ABVE 02/08/81 1.18

ABVE 11/22/82 0.94

SJVN 05/01/80 1.0

SJVN 08/01/80 1.0

SJVN 01/31/81 1.1

SJVN 11/09/82 1.14

SJVE 05/01/80 1.1

SJVE 08/01/80 1.1

SJVE 01/31/81 1.1

SJVE 11/09/82 1.07

MTPZ 02/07/81 1.14

MTPZ 12/23/81 1.15

Appendix E

Station parameter Information

Station Component Information

Format is as follows:

Unique Station identifier, station code, latitude, longitude, elevation, number of components, start and end dates, station location

901 ABV 18.7320 -64.3370 3.0 2 EHZ EHE 90. 0. 0. 90. 1979,3,25-1980,05,15 Anegada, British Virgin Islands
 901 ABV 18.7320 -64.3370 3.0 3 EHE EHN EHZ 0. 90. 0. 0. 90. 0. 1980,05,16-1981,2,07 Anegada, British Virgin Islands
 901 ABV 18.7320 -64.3370 3.0 3 EHE EHN EHZ 0. 90. 0. 0. -90. 0. 1980,02,8-1983,6,01 Anegada, British Virgin Islands
 902 AWIN 17.0450 -61.8600 371.0 1 EHZ 90. 0. 1979,1,1-1981,2,20 Boggy Peak, Antigua, Antigua and Barbuda, Lesser Antilles
 902 AWIN 17.0450 -61.8600 371.0 1 EHZ -90. 0. 1981,2,21-1983,6,01 Boggy Peak, Antigua, Antigua and Barbuda, Lesser Antilles
 903 BWI 17.6650 -61.7900 30.0 1 EHZ -90. 0. 1979,1,1-1979,08,19 Barbuda, Antigua and Barbuda, Lesser Antilles
 903 BWI 17.6650 -61.7900 30.0 1 EHZ 90. 0. 1979,08,20-1981,02,12 Barbuda, Antigua and Barbuda, Lesser Antilles
 903 BWI 17.6650 -61.7900 30.0 1 EHZ -90. 0. 1981,2,13-1983,06,01 Barbuda, Antigua and Barbuda, Lesser Antilles
 904 CGPV 17.7635 -64.5837 40.0 2 EHZ EHE -90. 0. 0. 90. 1979,1,1-1979,12,09 Cotton Garden Point, Saint Croix, U.S. Virgin Islands
 904 CGPV 17.7635 -64.5837 40.0 2 EHZ EHE 90. 0. 0. 90. 1979,12,10-1980,04,28 Cotton Garden Point, Saint Croix, U.S. Virgin Islands
 904 CGPV 17.7635 -64.5837 40.0 3 EHE EHN EHZ 0. 90. 0. 0. 90. 0. 1980,04,29-1981,2,4 Cotton Garden Point, Saint Croix, U.S. Virgin Islands
 904 CGPV 17.7635 -64.5837 40.0 3 EHE EHN EHZ 0. 90. 0. 0. -90. 0. 1980,2,5-1983,6,01 Cotton Garden Point, Saint Croix, U.S. Virgin Islands
 905 CGV 18.1328 -65.3173 130.0 2 EHZ EHE 90. 0. 0. 90. 1979,1,1-1980,04,17 Camp Garcia, Vieques, Puerto Rico
 905 CGV 18.1328 -65.3173 130.0 1 EHZ 90. 0. 1980,04,18-1981,3,2 Camp Garcia, Vieques, Puerto Rico
 905 CGV 18.1328 -65.3173 130.0 1 EHZ -90. 0. 1981,3,3-1983,6,01 Camp Garcia, Vieques, Puerto Rico
 906 CSJ 18.3830 -65.6180 66.0 2 EHZ EHE 90. 0. 0. 90. 1979,1,1-1980,04,15 Cape San Juan, Puerto Rico
 906 CSJ 18.3830 -65.6180 66.0 1 EHZ 90. 0. 1980,04,16-1981,2,2 Cape San Juan, Puerto Rico
 906 CSJ 18.3830 -65.6180 66.0 1 EHZ -90. 0. 1981,2,3-1983,6,01 Cape San Juan, Puerto Rico
 907 CUP 18.3350 -65.3090 120.0 2 EHZ EHE 90. 0. 0. 90. 1979,1,1-1979,04,18 Culebra Island, Puerto Rico
 907 CUP 18.3350 -65.3090 120.0 2 EHZ EHE -90. 0. 0. 90. 1979,4,19-1979,12,8 Culebra Island, Puerto Rico
 907 CUP 18.3350 -65.3090 120.0 2 EHZ EHE 90. 0. 0. 90. 1979,12,9-1980,04,19 Culebra Island, Puerto Rico
 907 CUP 18.3350 -65.3090 120.0 3 EHE EHN EHZ 0. 90. 0. 0. 90. 0. 1980,04,20-1981,2,05 Culebra Island, Puerto Rico
 907 CUP 18.3350 -65.3090 120.0 3 EHE EHN EHZ 0. 90. 0. 0. -90. 0. 1981,02,06-1983,6,01 Culebra Island, Puerto Rico
 908 GPV 18.4920 -64.4040 343.0 2 EHZ EHE 90. 0. 0. 90. 1979,1,1-1980,04,26 Gorda Peak, Virgin Gorda, British Virgin Islands
 908 GPV 18.4920 -64.4040 343.0 2 EHZ 90. 0. 1980,04,27-1981,1,31 Gorda Peak, Virgin Gorda, British Virgin Islands
 908 GPV 18.4920 -64.4040 343.0 1 EHZ -90. 0. 1981,02,1-1983,6,01 Gorda Peak, Virgin Gorda, British Virgin Islands
 909 MRN 18.0120 -63.0600 20.0 1 EHZ 90. 0. 1979,1,1-1981,2,20 Saint Martin, Netherlands Antilles
 909 MRN 18.0120 -63.0600 20.0 1 EHZ -90. 0. 1981,2,21-1983,6,01 Saint Martin, Netherlands Antilles
 910 MTP 18.0940 -65.5570 175.0 2 EHZ EHE 90. 0. 0. 90. 1979,1,1-1980,04,16 Mount Pirata, Vieques, Puerto Rico
 910 MTP 18.0940 -65.5570 175.0 3 EHE EHN EHZ 0. 90. 0. 0. 90. 0. 1980,04,17-1983,2,06 Mount Pirata, Vieques, Puerto Rico
 910 MTP 18.0940 -65.5570 175.0 3 EHE EHN EHZ 0. 90. 0. 0. -90. 0. 1980,02,7-1983,6,01 Mount Pirata, Vieques, Puerto Rico
 911 RRD 18.2360 -65.6180 40.0 2 EHZ EHE 90. 0. 0. 90. 1979,1,1-1980,04,15 Roosevelt Roads Naval Station, Puerto Rico
 911 RRD 18.2360 -65.6180 40.0 1 EHZ 90. 0. 1980,4,16-1981,2,2 Roosevelt Roads Naval Station, Puerto Rico
 911 RRD 18.2360 -65.6180 40.0 1 EHZ -90. 0. 1981,2,3-1983,6,01 Roosevelt Roads Naval Station, Puerto Rico
 912 SBN2 17.6201 -63.2267 470.0 1 EHZ 90. 0. 1979,12,21-1981,2,22 Saba, Netherlands Antilles
 912 SBN2 17.6201 -63.2267 470.0 1 EHZ -90. 0. 1981,2,23-1983,6,01 Saba, Netherlands Antilles
 913 SBN 17.6370 -63.2350 870.0 1 EHZ 90. 0. 1979,1,1-1979,12,04 Saba Peak, Saba, Netherlands Antilles
 914 SCV 17.7817 -64.7890 12.0 2 EHZ EHE -90. 0. 0. 90. 1979,1,1-1980,04,26 Saint Croix, U.S. Virgin Islands
 914 SCV 17.7817 -64.7890 12.0 1 EHZ 90. 0. 1980,04,27-1981,2,4 Saint Croix, U.S. Virgin Islands

914 SCV 17.7817 -64.7890 12.0 1 EHZ -90. 0. 1981,2,5-1983,6,01 Saint Croix, U.S. Virgin Islands
915 SJV 18.3450 -64.7620 280.0 2 EHZ EHE 90. 0. 0. 90. 1979,1,1-1980,04,21 Saint John, U.S. Virgin Islands
915 SJV 18.3450 -64.7620 280.0 3 EHE EHN EHZ 0. 90. 0. 0. 90. 0. 1980,04,22-1981,1,30 Saint John, U.S. Virgin Islands
915 SJV 18.3450 -64.7620 280.0 3 EHE EHN EHZ 0. 90. 0. 0. -90. 0. 1981,1,31-1983,6,01 Saint John, U.S. Virgin Islands
916 STKP 17.3800 -62.8270 366.0 1 EHZ 90. 0. 1976,10,01-1979,11,28 Saint Kitts, Saint Kitts and Nevis, Leeward Islands
917 SKBR 17.3410 -62.8400 200.0 1 EHZ 90. 0. 1979,11,30-1981,2,16 Saint Kitts, Saint Kitts and Nevis, Leeward Islands
917 SKBR 17.3410 -62.8400 200.0 1 EHZ -90. 0. 1981,2,17-1983,6,01 Saint Kitts, Saint Kitts and Nevis, Leeward Islands
918 SWIP 18.5980 -63.4260 15.0 1 EHZ 90. 0. 1979,1,1-1981,2,14 Sombrero Island, Lesser Antilles
918 SWIP 18.5980 -63.4260 15.0 1 EHZ -90. 0. 1981,2,15-1983,6,01 Sombrero Island, Lesser Antilles
919 VST 18.3540 -64.9570 372.0 3 EHE EHN EHZ 0. 90. 0. 0. -90. 0. 1979,1,1-1979,04,15 Saint Thomas U.S. Virgin Islands
919 VST 18.3540 -64.9570 372.0 3 EHE EHN EHZ 0. 90. 0. 0. 90. 0. 1979,4,16-1981,02,25 Saint Thomas U.S. Virgin Islands
919 VST 18.3540 -64.9570 372.0 6 EHE EHN EHZ ELE ELN ELZ 0. 90. 0. 0. -90. 0. 0. 90. 0. 0. -90. 0. 1981,02,26-1983,6,01
Saint Thomas U.S. Virgin Islands

Station Response Type Information

Format is as follows:

Station Type, Discriminator, VCO, Amplifier Response, Frequency, Other, Remarks
1, interproducts, interproducts, velocity, 1.0, upisland
2, interproducts, interproducts, velocity, 2.0, upisland
3, teledyne, interproducts, velocity, 1.0, downisland
4, teledyne, interproducts, velocity, 2.0, downisland
5, none, none, velocity, 1.0, VST only
6, none, none, "broadband", 1.0, VST only
7, interproducts, interproducts, velocity, 1.0, notch filter, CGV only
8, interproducts, interproducts, velocity, 2.0, notch filter, CGV only
9, teledyne, interproducts, velocity, 2.0, SJV only
10, teledyne, interproducts, displacement, 1.0, SJV only
11, teledyne, interproducts, velocity, 1.0, SJV only

Station Response History Information

Format is as follows:

“station”

Unique station identifier, station code, component response

Start date, end date

“gain:”, response in counts/cm, natural frequency,

component response type

station

901 ABV EHZ 001

1979,03,28-1979,12,11

gain: 7.5e7 1.0 1.0

TYPE 2

station

901 ABV EHZ 001

1979,12,12-1979,12,20

gain: 3.75e7 1.0 1.0

TYPE 2

station

901 ABV EHZ 001

1981,12,21-1983,02,07

gain: 3.75e7 1.0 1.0

TYPE 1

station

901 ABV EHZ 001

1981,2,08-1983,06,01

gain: 1.5e8 1.0 1.0

TYPE 1

station

901 ABV EHN 001

1980,05,09-1981,02,07

gain: 3.75e7 1.0 1.0

TYPE 1

station

901 ABV EHN 001

1981,02,08-1981,12,20

gain: 3.75e7 1.0 1.0

TYPE 1

station

901 ABV EHN 001

1981,12,21-1982,08,12

gain: 7.50e7 1.0 1.0

TYPE 1

station

901 ABV EHN 001

1982,08,13-1982,11,21

gain: 3.75e7 1.0 1.0

TYPE 1

station

901 ABV EHN 001

1982,11,22-1983,06,01

gain: 3.75e7 1.0 1.0

TYPE 2

station

901 ABV EHE 001

1979,03,28-1979,12,11

gain: 7.5e7 1.0 1.0

TYPE 1

station

901 ABV EHE 001

1979,12,12-1981,02,07

gain: 3.75e7 1.0 1.0

TYPE 1

station

901 ABV EHE 001

1981,02,08-1981,12,20

gain: 3.75e7 1.0 1.0

TYPE 1

station

901 ABV EHE 001

1981,12,21-1982,08,12

gain: 7.5e7 1.0 1.0

TYPE 1

station

901 ABV EHE 001

1982,08,13-1983,06,01

gain: 3.75e7 1.0 1.0

TYPE 1

station	station
902 AWIN EHZ 001	904 CGPV EHZ 001
1979,03,28-1979,08,07	1979,03,28-1979,12,08
gain: 7.5e7 1.0 1.0	gain: 1.5e8 1.0 1.0
TYPE 4	TYPE 2
station	station
902 AWIN EHZ 001	904 CGPV EHZ 001
1979,08,08-1979,12,17	1979,12,09-1981,02,03
gain: 7.5e7 1.0 1.0	gain: 7.5e7 1.0 1.0
TYPE 4	TYPE 2
station	station
902 AWIN EHZ 001	904 CGPV EHZ 001
1979,12,18-1982,03,14	1981,02,04-1981,12,14
gain: 3.75e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 4	TYPE 1
station	station
902 AWIN EHZ 001	904 CGPV EHZ 001
1982,03,15-1982,11,24	1981,12,15-1983,06,01
gain: 3.75e7 1.0 1.0	gain: 1.5e8 1.0 1.0
TYPE 3	TYPE 1
station	station
902 AWIN EHZ 001	904 CGPV EHN 001
1982,11,25-1983,06,01	1980,04,29-1981,02,03
gain: 3.75e7 1.0 1.0	gain: 7.5e7 1.0 1.0
TYPE 3	TYPE 1
station	station
903 BWI EHZ 001	904 CGPV EHN 001
1979,03,28-1979,08,19	1981,02,04-1981,12,14
gain: 1.5e8 1.0 1.0	gain: 9.35e6 1.0 1.0
TYPE 4	TYPE 1
station	station
903 BWI EHZ 001	904 CGPV EHN 001
1979,08,20-1980,05,11	1981,12,15-1982,07,31
gain: 7.5e7 1.0 1.0	gain: 7.5e7 1.0 1.0
TYPE 4	TYPE 1
station	station
903 BWI EHZ 001	904 CGPV EHN 001
1980,05,12-1981,02,12	1982,08,01-1983,06,01
gain: 7.5e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 3	TYPE 1
station	station
903 BWI EHZ 001	904 CGPV EHE 001
1981,02,13-1983,06,01	1979,03,28-1979,08,07
gain: 3.75e7 1.0 1.0	gain: 1.5e8 1.0 1.0
TYPE 3	TYPE 1

station	station
904 CGPV EHE 001	905 CGV EHZ 001
1979,08,08-1979,12,08	1979,03,28-1980,4,17
gain: 1.5e8 1.0 1.0	gain: 1.5e8 1.0 1.0
TYPE 1	TYPE 8
station	station
904 CGPV EHE 001	905 CGV EHZ 001
1979,12,09-1981,02,03	1980,04,18-1981,03,01
gain: 7.5e7 1.0 1.0	gain: 7.5e7 1.0 1.0
TYPE 1	TYPE 8
station	station
904 CGPV EHE 001	905 CGV EHZ 001
1981,02,04-1981,12,15	1981,03,02-1983,06,01
gain: 9.35e6 1.0 1.0	gain: 1.5e8 1.0 1.0
TYPE 1	TYPE 7
station	station
904 CGPV EHE 001	905 CGV EHE 001
1981,12,15-1981,07,31	1979,03,28-1980,04,18
gain: 7.5e7 1.0 1.0	gain: 7.5e7 1.0 1.0
TYPE 1	TYPE 7
station	station
904 CGPV EHE 001	907 CUP EHZ 001
1982,08,01-1983,06,01	1979,03,28-1979,12,07
gain: 3.75e7 1.0 1.0	gain: 1.5e8 1.0 1.0
TYPE 1	TYPE 2
station	station
906 CSJ EHZ 001	907 CUP EHZ 001
1979,03,28 1980,04,14	1979,12,08-1981,02,05
gain: 7.5e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 2	TYPE 2
station	station
906 CSJ EHZ 001	907 CUP EHZ 001
1980,04,15-1981,02,01	1981,02,06-1981,12,16
gain: 7.5e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 2	TYPE 1
station	station
906 CSJ EHZ 001	907 CUP EHZ 001
1981,02,02-1983,06,01	1981,12,17-1983,06,01
gain: 1.5e8 1.0 1.0	gain: 1.5e8 1.0 1.0
TYPE 1	TYPE 1
station	station
906 CSJ EHE 001	907 CUP EHN 001
1979,03,28-1980,04,15	1980,04,20-1981,02,05
gain: 7.5e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 1	TYPE 1

station	station
907 CUP EHN 001	908 GPV EHZ001
1981,02,06-1981,12,16	1979,04,28-1981,01,31
gain: 3.75e7 1.0 1.0	gain: 7.5e7 1.0 1.0
TYPE 1	TYPE 1
station	station
907 CUP EHN 001	908 GPV EHZ001
1981,12,17-1982,07,29	1981,02,01-1983,06,01
gain: 7.5e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 1	TYPE 1
station	station
907 CUP EHN 001	908 GPV EHE 001
1982,07,30-1983,06,01	1979,04,28-1980,04,26
gain: 3.75e7 1.0 1.0	gain: 7.5e7 1.0 1.0
TYPE 1	TYPE 1
station	station
907 CUP EHE 001	909 MRN EHZ 001
1979,03,28-1979,12,07	1979,03,28-1979,08,15
gain: 1.5e8 1.0 1.0	gain: 7.5e7 1.0 1.0
TYPE 2	TYPE 4
station	station
907 CUP EHE 001	909 MRN EHZ 001
1979,12,08-1980,04,19	1979,08,16-1979,02,20
gain: 3.75e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 2	TYPE 4
station	station
907 CUP EHE 001	909 MRN EHZ 001
1980,04,20-1981,02,05	1981,02,21-1983,06,01
gain: 3.75e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 1	TYPE 4
station	station
907 CUP EHE 001	910 MTP EHZ 001
1981,02,06-1981,12,16	1979,03,29-1980,04,16
gain: 3.75e7 1.0 1.0	gain: 1.5e8 1.0 1.0
TYPE 1	TYPE 2
station	station
907 CUP EHE 001	910 MTP EHZ 001
1981,12,17-1982,07,29	1980,04,17-1981,02,06
gain: 7.5e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 1	TYPE 2
station	station
907 CUP EHE 001	910 MTP EHZ 001
1982,07,30-1983,06,01	1981,02,07-1981,12,22
gain: 3.75e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 1	TYPE 1

station
 910 MTP EHZ 001
 1981,12,23-1983,06,01
 gain: 1.5e8 1.0 1.0
 TYPE 1
 station
 910 MTP EHN 001
 1980,04,17-1980,02,06
 gain: 3.75e7 1.0 1.0
 TYPE 1
 station
 910 MTP EHN 001
 1981,2,07-1981,12,22
 gain: 3.75e7 1.0 1.0
 TYPE 1
 station
 910 MTP EHN 001
 1981,12,23-1982,08,02
 gain: 7.5e7 1.0 1.0
 TYPE 1
 station
 910 MTP EHN 001
 1982,08,03-1983,06,01
 gain: 3.75e7 1.0 1.0
 TYPE 1
 station
 910 MTP EHE 001
 1979,04,02-1980,04,16
 gain: 7.5e7 1.0 1.0
 TYPE 1
 station
 910 MTP EHE 001
 1980,04,17-1981,02,06
 gain: 3.75e7 1.0 1.0
 TYPE 1
 station
 910 MTP EHE 001
 1981,02,07-1981,12,22
 gain: 3.75e7 1.0 1.0
 TYPE 1
 station
 910 MTP EHE 001
 1981,12,23-1982,08,02
 gain: 7.5e7 1.0 1.0
 TYPE 1

station
 910 MTP EHE 001
 1982,08,03-1983,06,01
 gain: 3.75e7 1.0 1.0
 TYPE 1
 station
 911 RRD EHZ 001
 1979,03,28-1979,08,07
 gain: 1.5e8 1.0 1.0
 TYPE 2
 station
 911 RRD EHZ 001
 1979,08,08-1979,04,14
 gain: 1.5e8 1.0 1.0
 TYPE 2
 station
 911 RRD EHZ 001
 1980,04,15-1980,02,01
 gain: 7.5e7 1.0 1.0
 TYPE 2
 station
 911 RRD EHZ 001
 1981,02,02-1983,06,01
 gain: 1.5e8 1.0 1.0
 TYPE 1
 station
 911 RRD EHE 001
 1979,03,28-1980,04,15
 gain: 7.5e7 1.0 1.0
 TYPE 1
 station
 913 SBN EHZ 001
 1979,03,28-1979,12,03
 gain: 3.75e7 1.0 1.0
 TYPE 4
 station
 912 SBN2 EHZ 001
 1979,12,19-1983,06,01
 gain: 3.75e7 1.0 1.0
 TYPE 4
 station
 914 SCV EHZ 001
 1979,03,28-1979,08,07
 gain: 7.5e7 1.0 1.0
 TYPE 2

station	station
914 SCV EHZ 001	915 SJV EHN 001
1979,08,08-1981,02,04	1981,01,31-1982,11,09
gain: 7.5e7 1.0 1.0	gain: 1.68e6 1.0 1.0
TYPE 2	TYPE 10
station	station
914 SCV EHZ 001	915 SJV EHN 001
1981,02,05-1983,06,01	1982,11,09-1983,06,01
gain: 1.5e8 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 1	TYPE 1
station	station
914 SCV EHE 001	915 SJV EHE 001
03,28,1979-1980,04,26	1979,03,29-1979,08,07
gain: 7.5e7 1.0 1.0	gain: 1.5e8 1.0 1.0
TYPE 1	TYPE 1
station	station
915 SJV EHZ 001	915 SJV EHE 001
1979,03,29-1979,08,07	1979,08,08-1980,04,21
gain: 1.5e8 1.0 1.0	gain: 1.5e8 1.0 1.0
TYPE 2	TYPE 1
station	station
915 SJV EHZ 001	915 SJV EHE 001
1979,08,08-1980,04,21	1980,04,22-1980,01,30
gain: 1.5e8 1.0 1.0	gain: 7.5e7 1.0 1.0
TYPE 2	TYPE 9
station	station
915 SJV EHZ 001	915 SJV EHE 001
1980,04,22-1981,01,30	1981,01,31-1982,11,08
gain: 7.5e7 1.0 1.0	gain: 1.68e6 1.0 1.0
TYPE 9	TYPE 10
station	station
915 SJV EHZ 001	915 SJV EHE 001
1981,01,31-1982,11,08	1982,11,09-1983,06,01
gain: 2.27e6 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 10	TYPE 1
station	station
915 SJV EHZ 001	917 SKBR EHZ 001
1982,11,09-1983,06,01	1979,11,30-1981,02,16
gain: 1.5e8 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 1	TYPE 4
station	station
915 SJV EHN 001	917 SKBR EHZ 001
1980,04,22-1981,01,30	1981,02,17-1983,06,01
gain: 7.5e7 1.0 1.0	gain: 3.75e7 1.0 1.0
TYPE 11	TYPE 3

station
916 STKP EHZ 001
1979,03,29-1979,11,20
gain: 7.5e7 1.0 1.0
TYPE 4
station
918 SWIP EHZ 001
1979,03,28-1979,08,15
gain: 7.5e7 1.0 1.0
TYPE 4
station
918 SWIP EHZ 001
1979,08,16-1981,02,14
gain: 3.75e7 1.0 1.0
TYPE 4
station
918 SWIP EHZ 001
1981,02,15-1983,06,01
gain: 3.75e7 1.0 1.0
TYPE 3
station
919 VST EHZ 001
1979,03,29-1979,04,15
gain: 3.75e7 1.0 1.0
TYPE 1
station
919 VST EHZ 001
1979,04,16-1979,08,08
gain: 5.4e7 1.0 1.0
TYPE 5
station
919 VST EHZ 001
1979,08,08-1983,06,01,
gain: 5.4e7 1.0 1.0
TYPE 5
station
919 VST EHN 001
1979,03,29-1979,04,15
gain: 3.75e7 1.0 1.0
TYPE 1
station
919 VST EHN 001
1979,04,16-1979,08,07
gain: 5.4e7 1.0 1.0
TYPE 5

station
919 VST EHN 001
1979,08,08-1983,06,01
gain: 5.4e7 1.0 1.0
TYPE 5
station
919 VST EHE 001
1979,04,16-1979,08,07
gain: 5.4e7 1.0 1.0
TYPE 5
station
919 VST EHE 001
1979,08,08-1983,06,01
gain: 5.4e7 1.0 1.0
TYPE 5
station
919 VST ELZ 001
1981,02,26 1983,06,01
gain: 3.87e4 1.0 1.0 at 1hz
TYPE 6
station
919 VST ELN 001
1981,02,26 1983,06,01
gain: 4.25e4 1.0 1.0 at 1hz
TYPE 6
station
919 VST ELE 001
1981,02,26-1983,06,01
gain: 4.25e4 1.0 1.0 at 1hz
TYPE 6

Appendix F Miscellaneous Comments

Ocean Bottom Seismometer data-

OBS data was also rescued. 15 OBS tapes were processed using "ping2ah -nys" to develop ah files that were checked by PQL. No time, however, was spent developing a modulated IRIG-C code reader to acquire the trigger time of each record. Besides the issue of the modulated IRIG time code, there is another issue that would need to be resolved if the data is to be used. That issue is that when the data were gathered the recording system used 2 read-write heads with a distinct time offset observed in recorded data. A channel common to each of the head allows the time offset to be removed.

Previous problem with tape OBS10 remains, and for OBS5 the second group of data, previously not captured, was recovered.

Data was generally taken from DLT tape image made in 1996. There were 15 OBS tapes written onto the DLT tape at that time. OBS tape 10 produced errors so none of its information was written. Data were extracted from the DLT tape and are given in this directory. DLT tape directories OBS5-15 are from the 1979 Conrad 22-12 cruise. The other directories are from the 1976 TIKI cruise.

The Channel OBS file used for demultiplexing is given below

Channels OBS

1 clk1 100
2 clk2 100
3 obsz 100
4 obsn 100
5 obse 100
6 hydr 100
7 unk1 100
8 unk2 100

1979 Conrad 22-12 Data

All processed with 7 channels as found in their header files. The 7 channels are: spzh, spzl, hydh, hydl, dm, time, and ref. When comparing the number of files created in 1996 and the number of file written onto the original tapes, we found significant discrepancies for OBS5, OBS8, OBS9, OBS10, OBS11, and OBS15.

OBS5 has 146 files and 78 recovered. The rest must still be on the tape after some EOF marks used to divide the tape into different OBS data units. The original tape would have to be reread to recover the data.

OBS8 has 341 files 226 are for OBSB6 and the rest are for OBSB5 (115). Originally we did not know how many data files were for OBSB5.

OBS9 we recovered 211 files with only 152 noted to OBSB7 on this tape. The other files appear to be for OBSO4 as per the file headers.

OBS10 produced errors in 1996. We tried again to read its 197 files, with no success

OBS11 has 221 of the files registered for OCSR4, the rest are on OBS15 tape. In total there are 334 files for OCSR4 some on this tape the rest on 15.

OBS15 the tape label says that there are 334 events for R4 but only 113 files are on this tape, the rest are on tape OBS11.

In summary, tapes for OBS5 and OBS10 need to be reread to get 100% data recovery.

1976 TIKI data

A readmeobs file found on the DLT tape indicated that there were 7 channels for the 1979 data (correct) and 8 channels for the 1976 data. Examining the headers we found 4 and 7 channels, but demultiplexing is still a problem to be solved. OBS1 data were demultiplexed with 8 channels successfully?. But the data don't all plot in pq1 with hz? complaints. OBS2 data were dmuxed with 4 channels, no complaints. OBS3 data the same. OBS4 contained some data from OCSR3, that was moved to OBS4b to be processed with 7 channels. The TIKI data herein was processed with 4 channels. The R3 data in OBS4b was processed with 5 channels.

List of OBS data rescued

1976

OBS	Number of Trigger Files
T1	159
T2	188
T3	48

1979

OBS	Number of Trigger Files
B1	79
B3	64
B4	253
B5	117
B6	224
B7	142
O1	66
O2	139
O3	21
O4	69
R2	371
R3	16
R4	334
R5	133